SFB/TRR 21 - Colloquium

22. Oktober 2010, Ulm

Dr. Peter Rabl

(Institut für Theoretische Physik, Universität Innsbruck)

Nano- and opto-mechanical transducers for quantum information processing

The demonstration of laser cooling techniques in opto-mechanical systems has recently attracted a lot of interest in the field of micro- and nano-mechanical devices and ground state cooling of the vibrational modes of micrometer-sized objects is within reach. Motivated by these experimental developments, I will describe in this talk potential applications for nano-mechanical systems in the context of quantum information processing, where the mechanical resonator acts as a coherent quantum transducer between magnetic, electric and optical forces. As a first example I will focus on solid state spin qubits which are coupled to the motion of magnetized mechanical resonators via magnetic field gradients. Provided that the resonators are charged, the magnetic moments associated with spin qubits can be effectively amplified to enable a coherent spin-spin interactions over distances exceeding 100 micrometers. In the second part of my talk I will show that analogous ideas in combination with opto-mechanical elements can be used to create a universal qubit-photon interface which does not rely on coherent optical transitions and therefore in particular enables long-distance quantum communication between various solid state qubits.

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Universität Ulm, Raum N24/251
Albert-Einstein-Allee 11, 89081 Ulm

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